The effectiveness of video-based training of an electronic medical record system: An exploratory study on computer literate health workers in rural Uganda

ÄNDAMÅLENLIGHETEN HOS VIDEOBASERAD UNDERVISNING AV ETT ELEKTRONISKT PATIENTJOURNALSYSTEM: EN EXPLORATIV STUDIE AV DATORVANA SJUKVÅRDSARBETARE PÅ UGANDAS LANDSBYGD

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The effectiveness of video-based training of an electronic medical record system: An exploratory study on computer literate health workers in rural Uganda

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ABSTRACT
Aims The purpose of this study is to explore the possibilities for video-based learning of computer systems in the field of medical education in rural sub-Saharan Africa.

Background Low-income countries are forced to perform healthcare services with resources already spread too thin. The use of electronic medical records can increase the cost-effectiveness of delivering healthcare services, but the low computer literacy in sub-Saharan Africa is an obstacle necessary to overcome. E-learning and video-based learning has the potential to partially solve this problem.

Methods User observations were conducted on five healthcare workers in rural Uganda. The users watched an instruction video, after which they performed an assessment test of an electronic medical record system.

Results Some effectiveness was perceived – but it was slight, and varied greatly between the test subjects. Computer experience is an important prerequisite for the success of e-learning initiatives. Effectiveness was higher for more simple tasks.

Conclusion This paper does not propose video-based learning as the only source of training for the target group. However, there is a possibility to envision video-based learning as a building block in a blended-learning strategy – utilising video-based learning for easier tasks and knowledge retention for users who are already familiar with the system.

SAMMANFATTNING
Syfte Studiens syfte är att undersöka möjligheterna för videobaserad undervisning av datorsystem i fältet medicinsk undervisning på landsbygden i sub-Saharan Africa.

Bakgrund Låginkomstländer tvingas idag utföra vård med knappa resurser. Användandet av elektroniska patientjournalsystem (electronical medical records) har potentialen att öka kostnadseffektiviteten i levererandet av vårdtjänster, men de låga datorkunskaperna i sub-Saharan Africa är ett hinder. E-learning och videobaserad undervisning har potentialen att till viss del få bukt med problemet.

Metod Användarobservationer utfördes på fem sjukvårdsarbetare på Ugandas landsbygd. Användarna såg en instruktionsvideo, varpå de utförde ett utvärderingstest (assessment test) i ett elektroniskt patientjournalsystem.

Resultat Viss ändamålsemhet (effectiveness) uppmättes – men den var låg, och varierade kraftigt mellan testsubjekten. Tidigare datorvana är en viktig förutsättning för att initiativ inom e-learning ska lyckas. Ändamålsemheten var större för uppgifter med lägre komplexitet.


Keywords
Video-based learning, e-learning, sub-Saharan Africa, Uganda, ICT4D, Electronic medical records, EMR, User observation

1. INTRODUCTION

1.1 Background
Despite research having shown there are clear benefits in incorporating information and communication technologies (ICT) in health care [1]–[3], the use of it is still scarce in less developed parts of the world. On the African continent, computer utilisation ratio is estimated at 1:100, meaning only one out of every 100 persons has access to a computer – and the computer utilisation ratio is even lower in rural areas, as most people living in urban areas at least have access to a computer at their workplace [4].

Furthermore, there is a global divide in healthcare, where low-income countries spent – in absolute terms – US$32 per capita in 2004. This is less than one per cent of what high-income countries spent on healthcare the same year, with a figure of US$3,724 [5]. Given this lack of healthcare resources in developing countries, there is a great need for cost-efficient healthcare solutions in parts of the world where healthcare resources are scarce. One solution, which could at least partially help to bridge the gap, is the increased use of e-health solutions in low-income countries [6]. The definition of what e-health is varies between authors, but this study will use the
definition presented by Omary [1]: “the longitudinal collection of electronic patient records for and about patients where health information is pertaining to the health of an individual”.

More specifically, one application of e-health is electronic medical records (EMR), defined by HIMSS – Healthcare Information and Management Systems Society – as “an application environment composed of the clinical data repository, clinical decision support, controlled medical vocabulary, order entry, computerized provider order entry, pharmacy, and clinical documentation applications […]” [7]. Benefits of successful implementation and utilisation of EMR systems are many – including increased patient security, reduction of medical errors, increased efficiency of physicians, reduced cost of delivering care, and greater efficiency in management processes [1], [2]. According to Clifford [5], the benefits of implementing an EMR in favour of a paper-based medical record system could prove to be greater in developing regions than an equivalent transition in developed ones – due to the often subpar record keeping systems used in many developing regions.

But while the need for these types of solutions is becoming more and more apparent, there are still major obstacles to overcome for the implementation of sustainable e-health solutions in sub-Saharan Africa to be successful. Asah [4] illuminates several contributing factors which inhibit computer usage in healthcare facilities, such as lack of IT infrastructure, insufficient computer literacy amongst healthcare providers, scarcity of technical support, and restricted access to computers – the latter due to the management’s distrust of letting the health workers use the equipment, despite of them possessing computer literacy. The challenges are further amplified in rural areas, with even less developed IT and power infrastructure, coupled with lower computer penetration [8].

Bearing these challenges in mind, a silver lining is taking shape of the attitudes of healthcare workers in sub-Saharan Africa. A study conducted in rural health facilities in Tanzania and Ghana found that, although the know-how and computer literacy was low, health providers have an overwhelmingly positive attitude towards computers, and “were optimistic about overcoming challenges associated with the introduction of computers in their workplace” [8]. Kipturgo et al. [9] found similar results, and furthermore propose that attitudes towards ICT and computers in sub-Saharan Africa have changed over time – from negative, to overwhelmingly positive. Research in the field has singled out two important factors pertaining to positive attitudes towards ICT. The first one is computer literacy coupled with previous exposure to computers, and the second one the age of the user – in which there is an inverse relationship between the user’s age and her positive attitude towards computers [8]–[11]. However, other studies have shown that the introduction of computers in health centres also can cause an adverse reaction [4] – stressing the cruciality of focusing and tailoring the implementation to the end-users, predominantly the nurses [9]. Also, due to the lack of computer literacy in concerned regions, providing adequate training and technical support is vital for implementation of e-health initiatives to be successful [8].

In the field of education in general, and medical education in particular, e-learning has been on the advance over the last few decades [12]. Research has so far given evidence of its effectiveness [10], offering learners more control of the content and pace of learning – in contrast to traditional ex cathedra lectures [12]. Definitions of what e-learning is vary, but this thesis will use one proposed by Bediang et al: “e-learning is the use of ICT and Internet to improve teaching and learning, and to foster exchange and collaboration at a distance” [10]. Furthermore, successful implementation and production of e-learning material has the potential to be less resource-demanding than using tutors [13], depending on factors such as number of students, tutors, and the geographical location of the involved persons. However, Garrison and Kanuka [14] adds nuance by claiming that the role of e-learning should be seen as a complement to – rather than a replacement for – traditional education, thus forming an effective and low-risk blended-learning strategy. Govindasamy is also one to sound a healthy note of caution, and is stressing the importance of not “hopping onto the e-learning bandwagon” without thoroughly basing your e-learning initiatives on a solid, pedagogic foundation [15].

One significant, albeit not fundamental, building block of e-learning is video-based education material, or video self-instruction (VSI). Studies have proven VSI’s effectiveness in different areas, from teaching cardiopulmonary resuscitation [13], [16] – CPR – to online courses [17]. Baggett [18] proposes that information transmitted through a movie is more memorable than the same information being transmitted only using audio – a conclusion supported by Kozma [19], who claims video coupled with audio can be beneficial for the cognitive learning process. Furthermore, e-learning and video-based instruction has the benefit over traditional tutoring of the possibility of providing standardised, uniform information, to ensure there is no lapse of quality between sessions [20].

1.2 MyChild system
This study will focus exclusively on the EMR system MyChild system, which was implemented by Shifo Foundation in Mukono district, Uganda, in 2013 [21]. As of April 2015, the system has been implemented in 48 health centres in Central region in Uganda, and operated by more than one hundred end-users. The system includes a number of applications to support child health services, tailored to address issues in vaccination service delivery in underserved areas. The system facilitates child registration, individual follow-up on children’s vaccination plans, and other health services which are part of preventive child health service delivery [ibid.].
Shifo Foundation is currently in the process of building and implementing a vaccine stock management module, providing real-time data of the current and historical usage of a health centre’s vaccine stock. This enables not only the ability to generate trustworthy reports, but also makes it easier to predict and prevent stock-outs before they occur.

1.3 Purpose
The purpose of this study is to explore the opportunities for video-based learning of data systems in the healthcare sector, in order to find new ways to increase the cost-efficiency of the knowledge transfer, knowledge retention, and continuous training of computer literate health workers – specifically in locations where healthcare resources are spread thin. The target group is users of MyChild system, further presented in section 1.3, but the results are applicable to similar user groups.

1.4 Research question
Given the purpose, the main research question this study will answer is the following:

*What is the effectiveness of using video-based instructions to teach computer literate health workers in rural Uganda updates in an electronic medical record system?*

“Effectiveness” will in this case be measured in i) the amount of knowledge transfer made during the test, and ii) the users’ attitudes towards the instruction video. Furthermore, I will facilitate answering the research question by answering the following sub-questions:

*What factors in the members of the target group are relevant in the success of video-based learning?*

*What is the target group’s attitude towards learning new applications using video-based learning?*

*What pedagogical aspects in the production of video-based education material are important to consider in order to aid the learning process of the target group?*

1.5 Delimitations
Great geographical distances, logistically challenging locations of health centres, and a high workload of the health personnel are the three main reasons to why the number of test subjects in this study is limited to five. This scarcity of eligible test subjects in combination with a narrow time frame limits the ambition of this thesis to not attempt to give a definite answer to whether video-based learning is effective for all health workers in sub-Saharan Africa or not – but rather to function as a pre-study, providing data on and insights into preliminary results, analysis, and obstacles to why video-based learning might or might not work. “Effectiveness” will therefore not be measured with the purpose to provide quantifiable and statistically valid results, but rather measured to illuminate qualitative tendencies – to point out a general direction to where one could venture within the field, rather than to provide a detailed roadmap to a successful implementation strategy.

2. METHODOLOGY
In order to give an answer to the research question, user observations were conducted, where the participants used the think-aloud method *active intervention*, explained more in detail in section 2.2.3. The participants watched an instruction video, explaining how to use a beta version of the stock management module – after which the participants were subjected to an assessment test, consisting of seven tasks covering the most important functions in the stock management module. The assessment test was followed by a shorter semi-structured interview, in order to tap into the attitudes of the users.

2.1 Instruction video
The instruction video used was a ten-minute non-interactive movie, explaining the purpose and most important functions of the stock management module, presented in section 1.2. It was created by the author, and follows to a large extent the ideas put forth in the pedagogics framework for developing e-learning content proposed by Govindasamy [15], with the ambition of having the instruction video being based on a solid pedagogical foundation. Animations were used to describe how the application may be used in the two processes of receiving vaccines and using the application in your daily work – due to the fact that animations provide a clearer, more direct way of presenting fundamental aspects of processes, compared to a ‘live’ video [22]. Moreover, the instructions in the video were presented by a Ugandan person, to ensure the English accent is familiar to the test subjects.

2.2 User evaluation

2.2.1 Scope
Five MyChild end-users participated in this study. Their ages spanned from being in their mid-twenties to their forties, they all had different work titles in the field of medicine and different educations. Furthermore – both genders were represented, and the users’ computer experience ranged from several years of experience to being taught just a few months ago. See table 1 for a more detailed display of the users. Apart from compensating for one of the user’s bus fare, no monetary compensation was given to the participants.

**Table 1 – Summary of the five participants in this study.**

<table>
<thead>
<tr>
<th>User</th>
<th>Age</th>
<th>Line of work</th>
<th>Computer literacy (1–4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>41–43</td>
<td>Management</td>
<td>Basic (3)</td>
</tr>
<tr>
<td>P2</td>
<td>38–40</td>
<td>Administrative</td>
<td>Basic (3)</td>
</tr>
<tr>
<td>P3</td>
<td>24–26</td>
<td>Management</td>
<td>Good (4)</td>
</tr>
<tr>
<td>P4</td>
<td>29–31</td>
<td>Medical practitioner</td>
<td>Beginner (1)</td>
</tr>
<tr>
<td>P5</td>
<td>40–42</td>
<td>Medical practitioner</td>
<td>Novice (2)</td>
</tr>
</tbody>
</table>
The user attributes are presented on the basis of having had significance in previously conducted research on the topic [9]–[11]. The “computer literacy” is a rough estimate of what could be apprehended by the author through the performed observations.

This study will use the definition of computer literacy proposed by Asah: “computer literacy could be defined as the competence of being able to demonstrate literacy, numeracy and computer skills needed to record, enter, store, retrieve and organize data essentials for the delivery of health-care services” [4]. The steps in this rating are: Beginner → Novice → Basic → Good. In order to ensure the anonymity the users were assured, their names are omitted from the results. The users’ genders are undisclosed due to this being an irrelevant attribute in determining the users’ performance, and all persons are referred to as ‘she’, regardless of gender. Furthermore, the users’ ages are represented by an interval rather than presenting an exact age, to strengthen the anonymity.

2.2.2 User observation and assessment test
The users were explained to how the assessment test would play out – by first being shown the instruction video, followed by being presented with a test version of the system, in which they were to perform eight given tasks covering what the instruction video taught them.

All but one user, P5, watched the movie in a relatively quiet room, without external participants, apart from the two test leaders consisting of the author and a colleague. P5 had to, due to logistical reasons, watch the movie outside a health center, where people were waiting and kids were playing. This setting was more audible and provided more distractions than the ones the other users were observed in.

Following watching the movie, the users were presented with an updated version of the MyChild system, the very same version covered in the instruction video. The users were told that the test was not assessing them, but rather the system – in an attempt to take some pressure off of the user [23]. It was also important that the users understood that the child data in the test system did not represent actual children – which, in earlier tests, had proven to be an obstacle, causing the users to be hesitant in performing actions with the fear it would cause errors in the live records.

Screen recording software was used to record user actions during the observation, along with sound recording, to record their expressed thoughts and concerns. This was also communicated clearly to, and agreed by, the users.

The test consisted of the following seven tasks:

1. Open the stock management module.
2. Check the current balance on BCG vaccine.
4. Receive the following: 150 Syringes, 0.05 ml from District store. Batch number: DT728UR29, expiry date: 01.06.2017.
5. Issue 20 doses of Polio, 20 0.5 ml syringes, 25 doses of BCG. Choose the ones which run out the soonest (nearest expiry date).
6. You’ve run out of polio, and need to get more in the fridge. Issue an additional 10 doses of Polio, and 10 0.5 ml syringes.
7. Seven doses of Polio were wasted due to “opened vials contaminated”. Return the remaining doses of Polio.

The tasks were printed on individual cards and shown, one by one, to the test subjects – in order to ensure that there were no varieties in the phrasing of the tasks. There was no finite time limit set on how much time they had to complete the task – but rather the users were given the next card after completing the current task, or if it was assessed that they had gone long enough to show that they lack understanding on how to complete the task. Furthermore, while they all are MyChild users, the stock management module was completely new to them.

2.2.3 Thinking aloud and active intervention
Oyugi et al. [24] proposes that user evaluation methods created in a western context, such as the think-aloud method, are not always suited to use in other parts of the world – East Africa being one of the examples in their research – due to cultural differences. Keeping this in mind, the users in this study were not specifically asked to think aloud during the assessment test, but rather asked open-ended questions during the observation such as “Do you remember what the instruction video said about this?”, “Why did you click there?”, and “What do you want to do now?”. This method, active intervention, has proven to be successful in eliciting thoughts from groups of users who are not used to or comfortable with expressing their thoughts verbally [25]. While the think-aloud method first and foremost is used to discover usability errors within a system [26], it is in this case used with the intent to see if the content of the movie stuck to the users and was guiding their actions in the system.
2.2.4 Interview
Following the assessment test, semi-structured interviews were held with the participants, to gather information on their occupation, education, their previous computer experience, their opinions towards the instruction video, and their own assessed verdict of how the test went. The latter to see if there was a discrepancy between what they thought of their own efforts, and how they actually performed.

3. RESULTS

3.1 Assessment test and user observation
In order to try to quantify the users’ overall performance, their performance on each task was graded on a scale from 0–2, according to table 2.

The results are sorted question-wise, and provide a description of the users’ overall performance. See table 3 for a summary of the users’ individual results. In order for the reader to better make sense of the findings, more detailed transcripts, screenshots and a “best practice” workflow can be found in appendix 8.1.

Table 2 – The rating system used in the assessment test

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>User failed task, due to little or no understanding.</td>
</tr>
<tr>
<td>1</td>
<td>User has shown some level of understanding, but still failed the task.</td>
</tr>
<tr>
<td>2</td>
<td>User has shown understanding and solved the task completely, or with trivial errors.</td>
</tr>
</tbody>
</table>

1. Open the stock management module.
Total score of all users: 10/10

All users completed this task without any problems at all. Attribution can most likely be given to the instruction video – as it is not obvious in the interface where a user can access the stock management module – given the fact that the button is fairly anonymous and lacks a text label.

2. Check the current balance on BCG vaccine.
Total score of all users: 0/10

None of the users completed this task. Most of them saw that there were two entries of BCG vaccine in stock, but they failed to realise the two entries were different batches. The instruction video, when presenting the HMIS (Health Management Information System) report tab – where one most easily sees the total balance – states “Here, you get an overview on the total amount of vaccines in stock”, but could have been clearer on explaining the presentation of vaccines with different batch numbers in the Stock tab. Furthermore, computer literacy was an irrelevant factor in predicting the success of the user in this task.

3. Receive the following: 450 doses of PCV from Bbanda HC2. Batch number: DH7786TR62, expiry date: 01.01.2017.
Total score of all users: 3/10

The instruction video explained the process of receiving vaccines twice, clearly explaining each step of the way. Yet all but one failed the task, for various reasons. Do notice that the task is a more complex one, compared to many of the others in the test. There are many steps which need to be completed without mistakes – and once you do err, the system provides little or no feedback to what you are doing wrong. This was the case with P5, who instead of entering new vaccines in the list overwrote the batch number and expiry date of current ones. The dangers of users accidentally doing this – compromising the system’s reliability – in a live system without realising it are obvious.

Observing the users during this task furthermore proved that user interface elements such as a dropdown menu are not at all self-explanatory for all user groups, as many of the participants struggled with this very element – from not even realising it was there, to confusing it with the stock list. All in all, a sufficient amount of computer literacy is a helpful prerequisite in completing this task.

Table 3 – Summary of the performance of all the participants.
A more detailed transcript of their individual performances can be found in Appendix 8.1.

<table>
<thead>
<tr>
<th>User</th>
<th>Age</th>
<th>Line of Work</th>
<th>Computer literacy (1–4)</th>
<th>Score task</th>
<th>Total score</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>41–43</td>
<td>Management</td>
<td>Basic (3)</td>
<td>2 0 0 0 2 2 0</td>
<td>6 (43%)</td>
</tr>
<tr>
<td>P2</td>
<td>38–40</td>
<td>Administrative</td>
<td>Basic (3)</td>
<td>2 0 1 2 1 2 1</td>
<td>9 (64%)</td>
</tr>
<tr>
<td>P3</td>
<td>24–26</td>
<td>Management</td>
<td>Good (4)</td>
<td>2 0 2 2 2 2 1</td>
<td>11 (79%)</td>
</tr>
<tr>
<td>P4</td>
<td>29–31</td>
<td>Medical practitioner</td>
<td>Beginner (1)</td>
<td>2 0 1 1 2 2</td>
<td>8 (57%)</td>
</tr>
<tr>
<td>P5</td>
<td>40–42</td>
<td>Medical practitioner</td>
<td>Novice (2)</td>
<td>2 0 0 0 2 0</td>
<td>4 (29%)</td>
</tr>
<tr>
<td>Summary</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>10 0 3 5 6 10 4</td>
<td>38/70 (54%)</td>
</tr>
</tbody>
</table>
4. Receive the following: 150 Syringes, 0.05 ml from District store. Batch number: DT728UR29, expiry date: 01.06.2017.

While the total score does not reflect a huge improvement in the users’ performance compared to the last task, it was obvious from observing the users that their performance had improved from the first attempt at receiving vaccines, indicating repetition of the task is an important cornerstone in the learning process.

5. It’s immunisation day. Issue 20 doses of Polio, 20 0.5 ml syringes, 25 doses of BCG. Choose the ones which run out the soonest (nearest expiry date).

The task of issuing vaccines was easy for most of the users, as it is a fairly simple task composed out of only three actions. P5 failed to finish this task – but it is to be noted that she was distracted during this very part of the instruction video and didn’t pay attention to what was being told. Amongst other observed difficulties were the failure in realising the green checkmark next to the text field is a button. One explanation could be lacking pedagogics during this very part of the instruction movie – where the on-screen actions and the audio instructions of the instructor differ with a few seconds. Noteworthy is also that there is – in this very screen – five different layouts of buttons and clickable elements, which could be a source of confusion for the first-time user.

Another interesting observation came from the session with P4 – the user with least amount of computer literacy. After she had entered the amount of vaccines she wanted to issue, she hesitated. When asked about this with the question “What are you doing now?”, she replied “The man in the movie said click the green (button) and it will enter”. However, the instructor in the movie didn’t say this – but rather “Click the green check mark or press the enter key”. It was obvious that she didn’t know which key the enter key was – further stressing the need for a user-centric approach with a focus on the users’ prior knowledge when developing e-learning material.

6. You’ve run out of polio, and need to get more in the fridge. Issue an additional 10 doses of Polio, and 10 0.5 ml syringes.

This proved to be a difficult task for the users. However – confusion could have come from the way the question was phrased; where the normal workflow in the system is to first return an amount of doses, after which the system calculates the number of doses wasted, based on the amount of the returned doses coupled with the amount of children the user has immunised during the session. The question, on the other hand, is phrased in a way which could make the user want to first specify somehow the amount of doses wasted. This proved to be counter-productive in two cases, where the users clicked the “Doses wasted” column, and stated they “couldn’t enter the amount of doses wasted”. Although, even in the cases where the users understood this – and clicked the “Return” button, they had a hard time calculating, based on how many doses issued and wasted, the amount of doses they should return.

3.2 Interview

In order to make sense of the users’ actions in the system and tap into their opinions regarding the instruction video, semi-structured interviews were held with the users. This section will cover the findings of the interviews, sorted in the two categories “Experience with and opinions towards ICT”, and “Attitudes towards the instruction video”.

3.2.1 Experience with and opinions towards ICT

Given the computer literacy within the user group, the results did not contradict the findings of Bediang et al. [10] – considering, for example, the previous conclusions that computer literacy and age are inversely relational. Neither did it disprove the findings of Kipturgo [9], who found that gender is not a crucial factor in regards to attitudes towards ICT in sub-Saharan Africa.

Furthermore, all users seemed to understand and appreciate the benefits of using computers in their work. Among named benefits were increased work speed, increased data security, and greater flexibility in outreach – i.e. when health personnel needs to go to a village to provide services instead of having patients come to the health center. One of the users, when asked what would happen if the system one day would not exist anymore, answered “They can’t! I don’t want to go back to the old system. – Why not? – Because they (District officials) give us… thirty books, you have to open, look, open, look… But here – you get a child ID number, and you get what you want. No wastage of time!”. Another one answered “…one of the worst things that could happen. I would feel bad. I love entering my work now”. And a third one: “We have people who’ve never used a computer before, but are now using it, thanks to MyChild system. (If the system were to disappear) a person would lose morale. A person is excited about knowing that he or she can come to work and use the computer.”

Two users also stated, in line with previously conducted research claiming computers cause the community to view the health practitioners as “modern health practitioners” [8], that parents in the local communities appreciate the introduction of computers: “Just entering the child’s ID into the computer, it encourages the
When comparing the findings from the interview with the results of the assessment test, it would be inappropriate to propose a relation between positive attitudes and a highly effective instruction video. One possible explanation to why there is a discrepancy between the users’ positive attitudes and their less than ideal results could be found by Gårdstedt et al. [27], where they – in a similar project and setting – found themselves having difficulties eliciting other than positive answers from participants in a survey – due to the fact that the participants benefitted from providing nothing but positive answers.

Another possible explanation could be found in the fact that, most of the time, the users didn’t even know they were committing mistakes and failing tasks, as this was not presented to them until the interviews had ended.

4. DISCUSSION

In this section, we will use the results to draw conclusions and propose implications, stemming from two of the sub-questions presented in section 1.4.

i. What factors in the members of the target group are relevant in the success of video-based learning?

Simple tasks can be inhibited by a discrepancy between the old and the new workflow. Task number two – “Check the current status on BCG vaccine” provided a good example of this. Even though the task should be a simple one – as no real user action is required – all participants failed the task. Having just stated this, it is important to briefly explain their current workflow when using the physical ledger to record vaccines. In the physical ledger, each page in the book is devoted to one type of vaccine, meaning – for example – there are multiple dedicated pages where you enter information about the information on solely BCG. On every page, the last non-empty row on the page is always the most recently updated one – and it is the one the current balance, stock at hand, is always written down on – see figure 2. In the stock application, each new row is a separate batch, and a separate type of vaccine. This discrepancy between the physical and digital workflow may very well be the reason why all of the users assumed the second entry was the total balance, even though they saw both entries.

Focus on pedagogics essential when developing e-learning material. In an instruction video, what you say and what you do matters – especially if what you say and do is not synchronised, as was the case with the instructions for receiving vaccines. The speaker voice explains all the steps in the process of receiving vaccines, after which he actually performs the steps, in silence. While many users did complete this task without major remarks, it was obvious from observing them while watching the movie this was an element of confusion to many of the participants.

Certain amount of computer literacy crucial prerequisite. Consider task no. 4, where the users repeated the “receiving vaccines” process. A lot of the errors observed here were of the discreet sort which are avoidable and obvious almost exclusively to those with a

3.2.2 Attitudes towards the instruction video

Questions were also asked about the users’ opinions on the instruction video, to see if there was any relation between positive attitudes towards the video, and the users’ performance – in accordance with sub-question 2: “What is the target group’s attitude towards learning new applications using video-based learning?”. All users expressed positive opinions about the instruction video. One user stated: “It’s very okay. I just listened to it, and then I was capable of entering the exercise you gave me. It’s very clear”. Noteworthy is that this was said by one of the users who had major difficulties in completing the tasks. When further asked about this – why she thought it was a good video even though she struggled with several of the tasks – she replied: “For the first time using the system with little knowledge or skills with computers… I could not enter all the things right. But at least, I could really enter some things. And if you happen to be stuck, you can see the movie again”. The last thing she said, about repeating the movie, was also stated by another user: “Ok, maybe I have to repeat it (the video) again. I was making some errors during the test. – If you could see it again, do you think you would learn more? ‘I would perfect my performance.’

Only one user, P3, had previously seen an instruction video to use computer systems. This was also the youngest user, the one who had the most computer literacy, and had been using computers in school and at internet cafés since 2005. When asked if the user thought it was its computer literacy which could be attributed to completing most of the tasks with only minor problems, the user replied: “I don’t think so. It (the video) was quite helpful. I wouldn’t find it easy to use if I hadn’t gone through the video. If really we could bring in more videos, that would be good”. Furthermore, the rest of the users also expressed positive attitudes to the video, stating things like “It was very clear. It was giving right information directly from the beginning”, and “It was good. I understood everything”.

mother or father to bring the child in for vaccination next time”, and “Sometimes even, they (health practitioners) brag when they’re using the computer. Like a status thing”.

None of the users have a computer at home, although they all are in possession of a mobile phone or smartphone. Moreover, all of the users had colleagues who didn’t use computers – the main two reasons being lack of computer training, and fear. Or as one of the users put it: “They (the colleagues) don’t want computer knowledge. Out of fear. Like me, the first time – I was fearing the computer. And now – this computer is like phone. You can search, search, search… And end up getting exactly what you want!”. This was echoed by another user: “You know… people have fear of some things. They might fear the machine, because that person doesn’t know how to use the machine. I would encourage them, however, to go and love technology. Because technology is the way to go, ha ha!”

It’s very clear
certain amount of computer literacy. Two examples: i) the user accidentally closing the active entry by clicking outside of it without understanding what went wrong, and ii) understanding the need to ‘commit’ text inputs by pressing the enter key before moving on. It is highly unlikely that an instruction video, regardless of its quality and how much resources have been put into creating it, can counter-act these types of errors being made by a user with insufficient computer literacy.

Difficult to develop a “one size fits all” instruction video. In the pedagogics framework proposed by Govindasamy [15], the first step in creating e-learning material is to make a learner profile. However, it is unlikely one can create learning material tailored to both users such as P4 – who confuses the letter ‘o’ with the number zero and doesn’t know which key the ‘enter’ key was – and users like P3, who is a digital native and has been using computers for years.

iii. What pedagogical aspects in the production of video-based education material are important to consider in order to aid the learning process of the target group?

More simple tasks had a higher rate of success than more complicated ones. The simpler tasks, such as “1 – Open the stock management module” and the two tasks devoted to issuing vaccines has a higher rate of success than for example the ones where the users received vaccines, which are significantly more complex.

Repetition proved beneficial in the learning process. When considering the results from task 3-4, and 5-6 – the tasks which were repetitions – all of the participants performed better the second time around. It is far from controversial to propose that repetition of knowledge increases the chance of one learning said knowledge, and the findings of this study do not debunk this idea. What is interesting to consider is that it was not the repetition of the instruction video which led to an improved performance – since they only watched it once – but the repetition of the task itself.

Despite sufficient learning material, focus on user experience still important. While having your programs built with a clear user experience focus may not be an absolute necessity for e-learning initiatives to work properly, lack of user experience can very easily be an obstacle which inhibits the learning process. As an example it was seen that, when receiving vaccines, inexperienced computer users confused the drop-down menu and the vaccine list, due to the drop-down menu overlapping the vaccine list (appendix 8.1, fig. 8.3).

4.2 Method, and future work
This research was quite limited in terms of number of participating users, for which the underlying reasons have been presented in section 1.5. If one wishes to make a more definite verdict on the effectiveness of video-based material for the user group – computer literate health workers in sub-Saharan Africa – a more comprehensive study is required. Preferably one comparing two similar groups of users’ performance in the system – one group who first watches the instruction video, and another group who tries to perform the tasks without having seen the instruction video. This in order to try and pinpoint what can be attributed to the video, and what is already fairly intuitive for the users. In order to more easily get a

Figure 2 – Comparison of the current workflow with the physical ledger, and the stock management module. In the physical ledger, the total balance is found in the last non-empty row on each page. In the system, the total balance is the sum of all BCG entries.
hold of test subjects, one could also entertain the thought of performing the study by broadening the test group – not limiting oneself to exclusively computer literate health workers, but perhaps broaden the scope to just computer literate people. Moreover, other future work could yield interesting results assessing the effectiveness of video-based instruction, but comparing computer literate persons with non-computer literate persons.

Considering we have seen some positive outcomes from the results in terms of effectiveness and attitudes, future work could further investigate which user groups benefit the most from video-based instruction. Furthermore – future research could try to make an assessment of what type of tasks and/or systems are more suited than others to be taught using video-based learning, thus optimising the effectiveness of utilising video-based learning in a blended-learning strategy.

Although, the lack of IT infrastructure and equipment could prove to be obstacles difficult to overcome – transferring video in a low bandwidth setting is a scenario one wishes to avoid. Therefore, there could be a lot to gain in exploring if there are alternative means to reach the same end – for example, by using modern, interactive web technologies and animations to reach the same results as a video, while using a mere fraction of the bandwidth. This could also, in a future scenario, open up possibilities of tailoring the content and presentation to the user, in order to reduce unnecessary friction for the viewer. For example – by customizing the presenter’s age, gender, clothes and language, depending on the location and context in which the instructions are presented.

5. CONCLUSION

This has been an explorative field study assessing the effectiveness of video-based instruction for teaching a data system to frontline health workers in rural Uganda, where the focus has been on the following research question:

What is the effectiveness of using video-based instructions to teach computer literate health workers in rural Uganda updates in an electronic medical record system?

The findings of this paper do not contradict the research claiming that video-based learning has potential in many applications of modern-day education. Positive indications has been seen, albeit sometimes very slight, that the video-based instruction used in this thesis managed to teach the user group how to use certain parts of the application – thus indicating some amount of effectiveness. Moreover, the attitudes towards video-based learning were very positive. However – given the dire implications of entering erroneous data in health management information systems, it is crucial that the type of errors committed by the user group in this test must not happen in a live version of the system, to not undermine the users’ trust for the system’s accuracy. Keeping this in mind, it is in this stage more realistic to envision video-based instruction either to teach minor updates in the system, or as a possible method of knowledge retention for users who already use the system – but who are in need of refresher training – rather than as a standalone source of first-hand training.

6. ACKNOWLEDGEMENTS

This paper would never have been possible without the help of certain people. Malin Westerlind has been my trusted research partner throughout the entire journey. The entire Shifo organisation took us in and provided us with support, wisdom and laughter – and Shuhrat Yusuf, the embodiment of a “can do” attitude, has been the best field supervisor one could hope for. The three Germans in Kampala made our stay even more pleasant than it already was, and taught us the virtue of proper planning. Elina Eriksson, my academic supervisor, was a linchpin throughout the entire process and made sure this text is actually comprehensible – and honoured members of the supervisor group came with insightful comments and revision suggestions. Finally – my warmest appreciations to family and friends, for love and support.

7. REFERENCES


8 APPENDIX

8.1 Transcript of user performance during the assessment test

1. Open the stock management module

**Best practice:** Click the purple “Stock” icon (with the box icon) in the top right corner.

Figure 8.1 – Screenshot of the main screen, with the purple stock management module button in the top right corner.

Table 8.1 – User performance on task 1. Note: The decision was made that time here is irrelevant, since all the users in less than a few seconds found and clicked the purple stock icon.

<table>
<thead>
<tr>
<th>Name</th>
<th>Score (0–2)</th>
<th>Time (m:s)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>2</td>
<td>N/A</td>
<td>User followed best practice.</td>
</tr>
<tr>
<td>P2</td>
<td>2</td>
<td>N/A</td>
<td>Same as above.</td>
</tr>
<tr>
<td>P3</td>
<td>2</td>
<td>N/A</td>
<td>Same as above.</td>
</tr>
<tr>
<td>P4</td>
<td>2</td>
<td>N/A</td>
<td>Same as above.</td>
</tr>
<tr>
<td>P5</td>
<td>2</td>
<td>N/A</td>
<td>Same as above.</td>
</tr>
</tbody>
</table>
2. Check the current balance on BCG vaccine. What is it?

**Best practice:** Click the “HMIS Report” tab, after which you see the total amount of the BCG vaccine (*end balance*). Alternate solution: In the “Stock” tab, add the total balance of all entries of the BCG vaccine.

![Figure 8.2 – Screenshot of the HMIS Report screen, where you get an overview of the total stock (end balance)](image)

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Start balance</th>
<th>Doses received</th>
<th>End balance</th>
<th>Immunised, &lt; 1 y</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCG</td>
<td>0</td>
<td>150</td>
<td>50</td>
<td>16</td>
</tr>
<tr>
<td>Polio</td>
<td>0</td>
<td>950</td>
<td>240</td>
<td>16</td>
</tr>
<tr>
<td>DPT</td>
<td>0</td>
<td>400</td>
<td>400</td>
<td>0</td>
</tr>
<tr>
<td>Measles</td>
<td>0</td>
<td>500</td>
<td>500</td>
<td>0</td>
</tr>
<tr>
<td>Rota Virus</td>
<td>0</td>
<td>350</td>
<td>350</td>
<td>0</td>
</tr>
<tr>
<td>PCV</td>
<td>0</td>
<td>950</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>TT</td>
<td>0</td>
<td>600</td>
<td>599</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 8.2 – User performance on task 2.

<table>
<thead>
<tr>
<th>Name</th>
<th>(0–2)</th>
<th>Time (m:s)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>0</td>
<td>1:20</td>
<td>User did not click the “HMIS Report” tab, but rather saw the first entry of BCG where the total balance was “599”, and answered “599”. After a few seconds, she saw the second entry of BCG, with a different batch number, and answered “230”. Correct answer was 599 + 230 = 829. Same as above – although during her reasoning, she did state the added answer from both entries, but she changed her mind and submitted the latter (230) as her answer.</td>
</tr>
<tr>
<td>P2</td>
<td>0</td>
<td>1:26</td>
<td>As previous users, she first answered the total balance of the first BCG batch, but changed her mind when she saw the second one – and answered the total balance of the second batch.</td>
</tr>
<tr>
<td>P3</td>
<td>0</td>
<td>0:59</td>
<td>She saw the first batch, and answered the total balance of it. She didn’t see the second entry in the stock.</td>
</tr>
<tr>
<td>P4</td>
<td>0</td>
<td>0:12</td>
<td>Similar to P4, she saw the first entry of BCG, and answered the total balance of that batch. She didn’t see the second BCG entry.</td>
</tr>
</tbody>
</table>
3 – Receive the following: 450 doses of PCV from Bbanda HC2, Batch number: DH7786TR62, expiry date; 01.01.2017.

**Best practice:** Click the “Receive” button in the lower right corner, enter the given values in each field in the new row that appears, and click “save”.

Figure 8.3 – Screenshot of the *receive vaccines* workflow. Note the similarities between the drop-down menu and the vaccine list.

![Screenshot of the receive vaccines workflow](image)

Table 8.3 – User performance on task 3.

<table>
<thead>
<tr>
<th>Name</th>
<th>Time</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>0</td>
<td>8:54</td>
</tr>
<tr>
<td>P2</td>
<td>1</td>
<td>2:01</td>
</tr>
<tr>
<td>P3</td>
<td>2</td>
<td>2:11</td>
</tr>
<tr>
<td>P4</td>
<td>0</td>
<td>7:06</td>
</tr>
<tr>
<td>P5</td>
<td>0</td>
<td>5:12</td>
</tr>
</tbody>
</table>
4 – Receive the following: 150 Syringes, 0.05 ml. District store. Batch number: DT728UR29, expiry date: 01.06.2017.

Best practice: Same as in task 3.

Table 8.4 – User performance on task 4.

<table>
<thead>
<tr>
<th>Name (0–2)</th>
<th>Time</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>0</td>
<td>4:15</td>
</tr>
<tr>
<td>P2</td>
<td>2</td>
<td>2:07</td>
</tr>
<tr>
<td>P3</td>
<td>2</td>
<td>1:16</td>
</tr>
<tr>
<td>P4</td>
<td>1</td>
<td>5:21</td>
</tr>
<tr>
<td>P5</td>
<td>0</td>
<td>2:26</td>
</tr>
</tbody>
</table>

Figure 8.4 – Screenshot of the issue vaccines workflow.

5 – Issue 20 doses of Polio, 20 0.5 ml syringes, 25 doses of BCG. Choose the ones which run out the soonest (nearest expiry date).

Best practice: Hover the vaccine entry you want to issue. Click the “Issue” button which appears. Enter the amount you want to issue. Click the green checkmark or “enter” key.

Table 8.5 – User performance on task 5.

<table>
<thead>
<tr>
<th>Name (0–2)</th>
<th>Time</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>2</td>
<td>1:40</td>
</tr>
<tr>
<td>P2</td>
<td>1</td>
<td>3:48</td>
</tr>
<tr>
<td>P3</td>
<td>2</td>
<td>1:40</td>
</tr>
<tr>
<td>P4</td>
<td>2</td>
<td>1:07</td>
</tr>
<tr>
<td>P5</td>
<td>0</td>
<td>3:38</td>
</tr>
</tbody>
</table>
6. You’ve run out of polio, and need to get more in the fridge. Issue an additional 10 doses of Polio, and 10 0.5 ml syringes.

**Best practice:** Almost identical to the previous task. On the vaccines you’ve already issued, you can find an “Issue more” button instead of an “Issue” button. Click it, and enter the amount of vaccines you want to issue.

<table>
<thead>
<tr>
<th>Name</th>
<th>(0–2)</th>
<th>Time (m:s)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>2</td>
<td>1:00</td>
<td>User followed best practice.</td>
</tr>
<tr>
<td>P2</td>
<td>2</td>
<td>2:10</td>
<td>The user, as in the previous step – struggled with realising the green checkmark is the <em>call to action</em> – but when she paused for a second and considered her options, she hovered the checkmark; saw that the cursor turned into a hand, clicked the check mark. User followed best practice.</td>
</tr>
<tr>
<td>P3</td>
<td>2</td>
<td>1:02</td>
<td>User followed best practice.</td>
</tr>
<tr>
<td>P4</td>
<td>2</td>
<td>2:18</td>
<td>Due to a possible bug in the system, there was no “Issue more” button next to the Polio vaccine, even though she had issued Polio, and the stock was not full. She instead got the instructions of only issuing more syringes – which she did according to best practice.</td>
</tr>
<tr>
<td>P5</td>
<td>2</td>
<td>1:01</td>
<td>The user followed best practice, and showed remarkable improvement from the previous task.</td>
</tr>
</tbody>
</table>

7. Seven doses of Polio were wasted due to “opened vials contaminated”. Return the remaining doses of Polio.

**Best practice:** Click the big, red text which says “Return”. Enter the amount of doses you want to return, and press “enter key” or green check mark. If the system calculates you’ve wasted doses, a pop-up window appears, prompting you to select the reasons for wastage. Do so, and press the “Ok” button.

<table>
<thead>
<tr>
<th>Name</th>
<th>(0–2)</th>
<th>Time (m:s)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>0</td>
<td>2:45</td>
<td>The user really wanted to click the “Doses wasted” column, to specify how many doses have been wasted, rather than the “return” button first. This could be due to the complex nature of the question; which prompts the user to specify how many doses have been wasted, and not how many doses which are to be returned.</td>
</tr>
<tr>
<td>P2</td>
<td>1</td>
<td>1:09</td>
<td>She understood the process of returning vaccines, without problems. However – she failed in realising how many doses to return.</td>
</tr>
<tr>
<td>P3</td>
<td>1</td>
<td>1:20</td>
<td>He understood the principals of returning, but also failed due to the complex example.</td>
</tr>
<tr>
<td>P4</td>
<td>2</td>
<td>2:58</td>
<td>User followed best practice.</td>
</tr>
<tr>
<td>P5</td>
<td>0</td>
<td>3:32</td>
<td>She found it eventually, but it was obvious you can’t give credit to the movie.</td>
</tr>
</tbody>
</table>